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780 nm Diode Lasers for Atomic Physics

Description

This poster presents the results of the summer research project conducted by Bryson Vivas, Simone Carpenter, and Jenny Novak. The research was supervised by Dr. Andrew Dawes and conducted in the Photonics and Quantum Optics Lab of Pacific University.

Keywords

Laser, Diode, Atomic Physics, Poster, Murdock

Disciplines

Atomic, Molecular and Optical Physics | Optics

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780 nm Diode Lasers for Atomic Physics

Bryson Vivas, Simone Carpenter, Jenny Novak and Dr. Andrew M.C. Dawes
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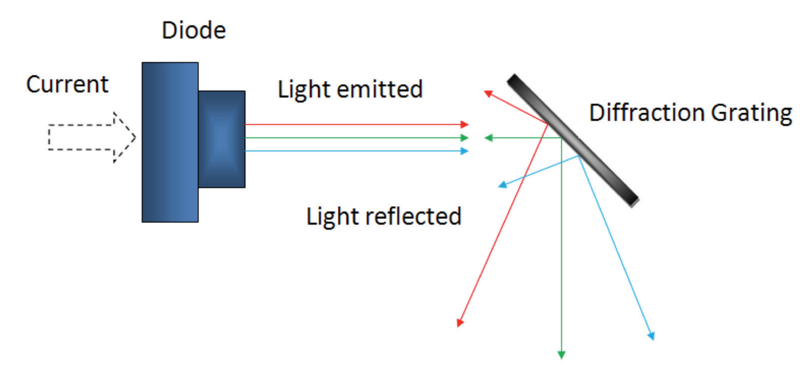
Introduction:

Our goal was to construct three tunable lasers that operate at 780 nm.

We will be using these lasers for cooling and trapping Rubidium atoms.

Diode Laser Design [1,2]:



Laser diode – light source

Diffraction Grating

Diffracts different wavelengths emitted from the diode.

Reflects out of the laser and back into the diode.

Piezo Stack

Changes length of laser cavity and grating angle by varying the voltage

Fine-tuning of wavelength

Piezo Disc

Changes length of laser cavity by varying the voltage

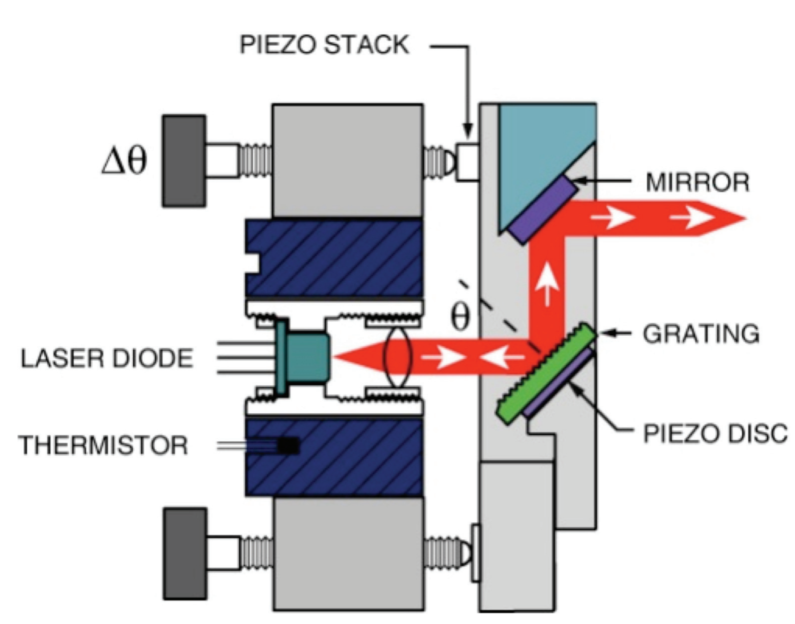
Thermistor

Measures the temperature for stabilization

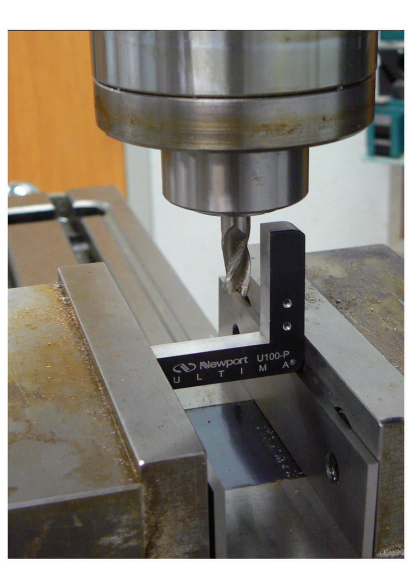
Δθ

Changes the length of the laser cavity and grating angle

Course (manual) tuning



Laser Construction:



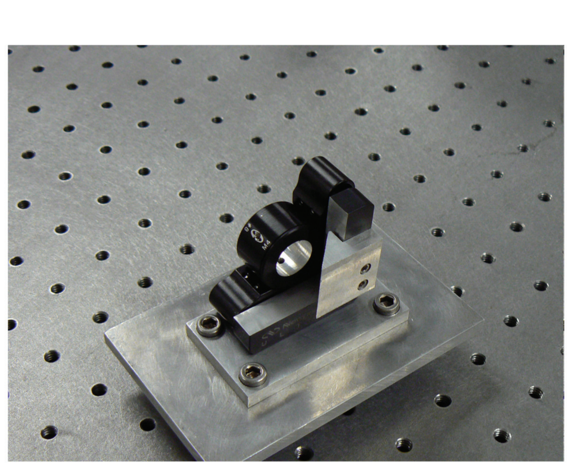
Newport Ultima Mount (U100-P, $75)

Cut L-shape with milling machine

Drill and tap mounting holes for the grating mount

Diode tube holder

Bore hole to hold laser diode tube



Aluminum Grating Mount

Mounting plates

Top plate mounts Newport mount

Bottom plate mounts to steel base (heat sink)

Course tuning

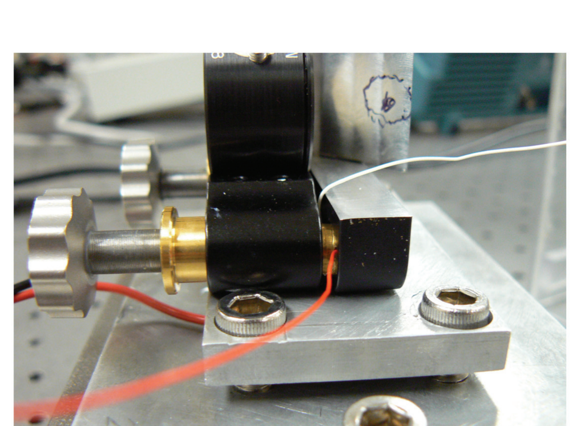
Flex piezo

Brass piezo holder

Thermoelectric cooler (TEC)

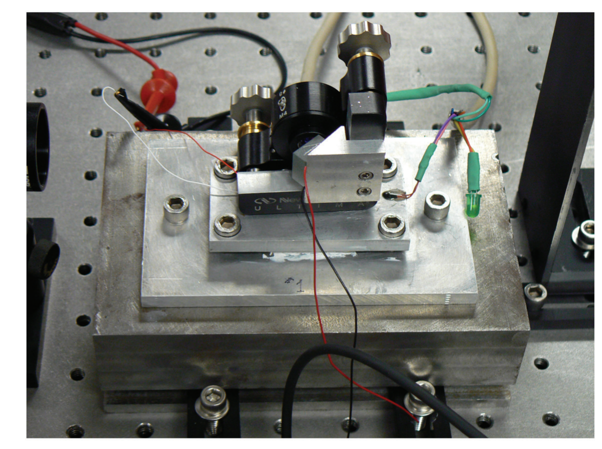
Between mounting plates

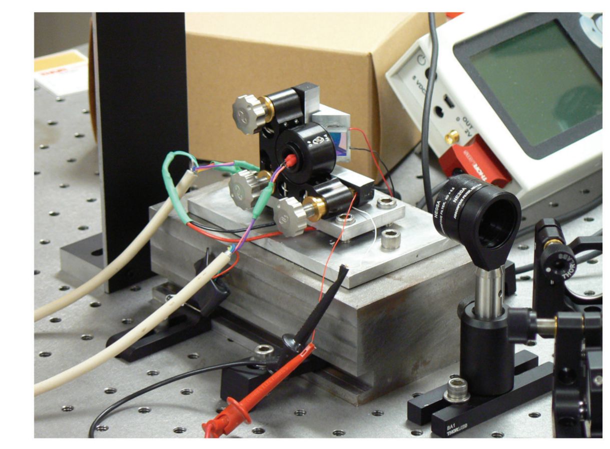
Controls the temperature of the laser



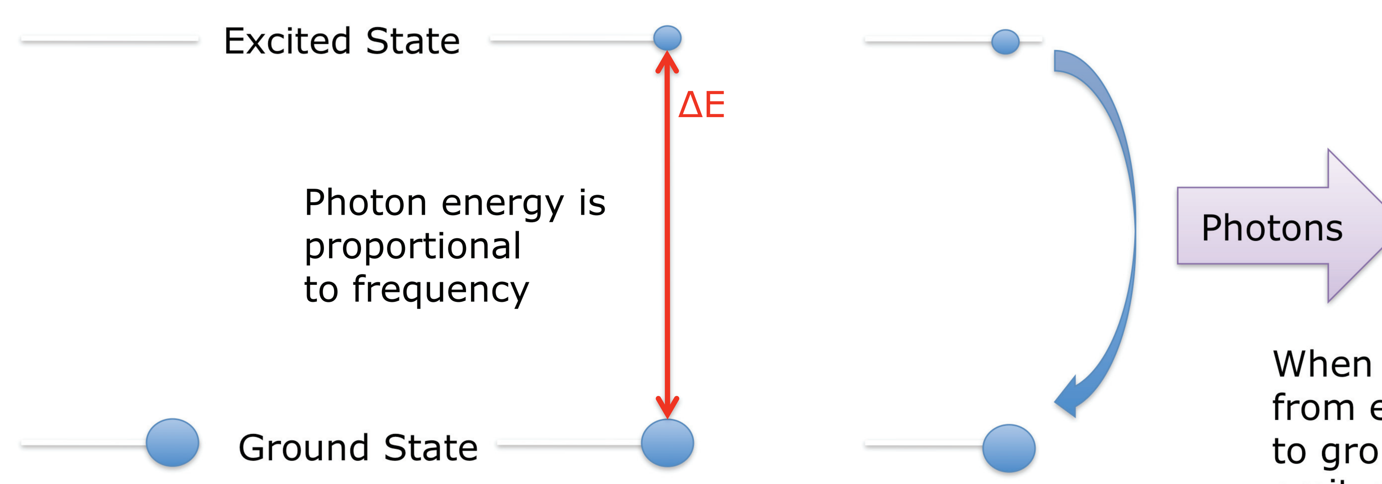
Finished Product

One of three working lasers tuned to 780 nm.





Two level Atoms:



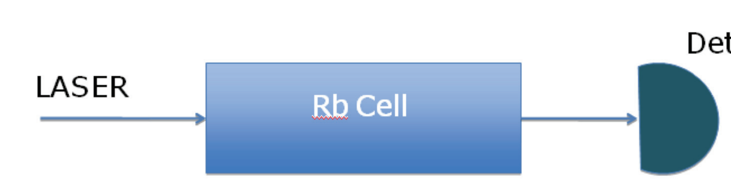
When atoms decay from excited state to ground state, they emit photons.

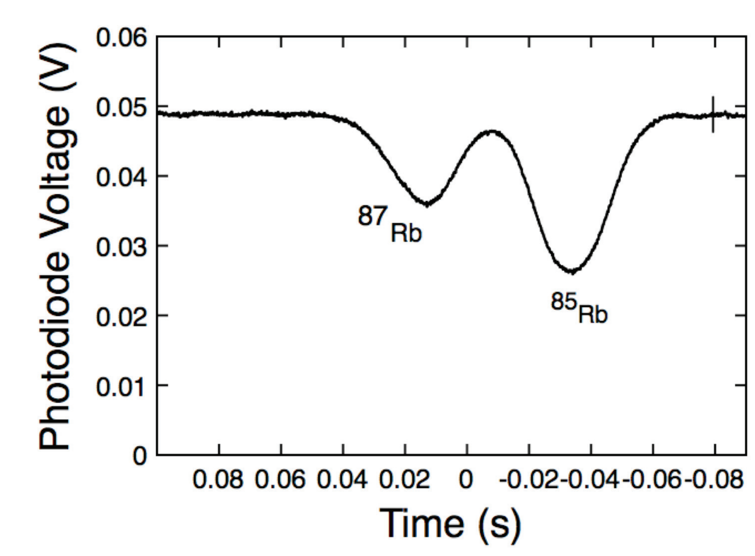
Linear Spectroscopy:

ω_0 is resonance frequency

ω is the laser frequency

Transmission decreases near $\omega_0=\omega$





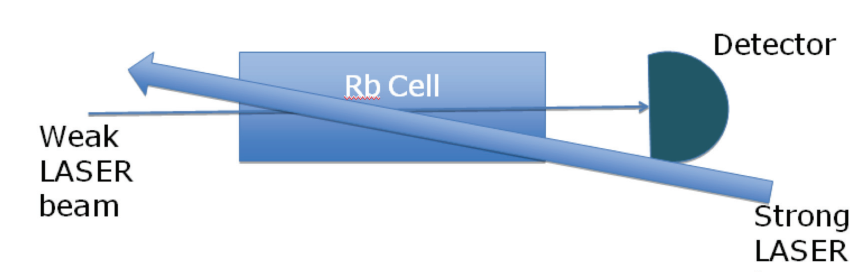
Non-Linear Spectroscopy:

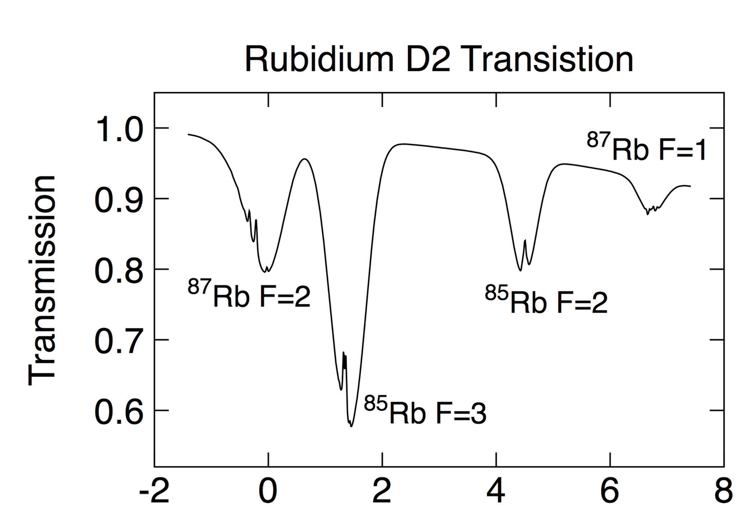
Goal: avoid effects of atomic motion

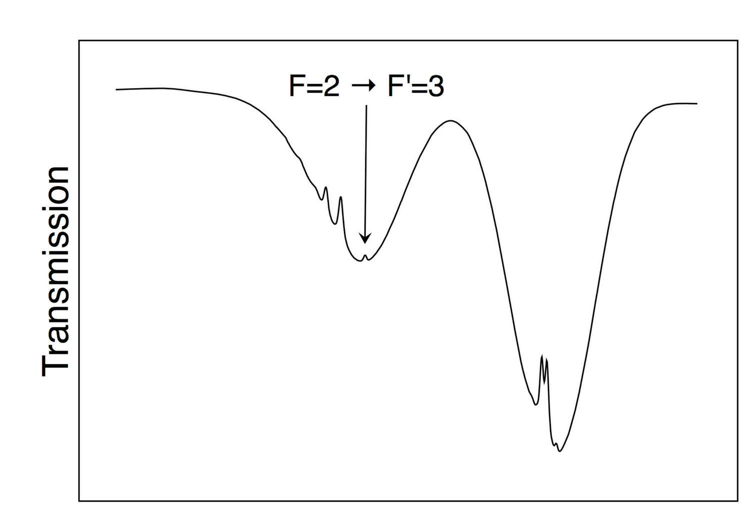
Both beams on resonance if v=0 and $\omega_0=\omega$.

For moving atoms, two beams have different ω (Doppler effect).

Narrow transmission spikes for $\omega_0=\omega$







Future Goals:

Build a frequency stabilization system based on magnetic-field-induced resonance shifts [3].

Lock frequency to F=2 to F'=3 transition.

References:

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